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THE RESPONSE OF FLUORESCENT ORGANIC MATTER TO OZONE TREATMENT IN FRESHWATER PILOT RECIRCULATING AQUACULTURE SYSTEMS

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Water quality in intense recirculating aquaculture systems (RAS) is characterised by the accumulation of organic and inorganic compounds, potentially deteriorating the water quality. Ozone has been implemented in RAS as a continuous water treatment technology improving water quality by oxidizing organic matter and reducing bacterial abundance. The analytical efforts to detect and monitor organic matter (DOM) in aquatic systems have included absorption spectroscopy of the coloured fraction (CDOM). A part of CDOM also fluoresces (FDOM). FDOM fraction has been widely used in aquatic environments as a quantitative and qualitative measure of DOM. FDOM can be characterised by the fluorescence excitation-emission matrix (EEM) spectroscopy which can be further decomposed mathematically with methods such as parallel factor (PARAFAC) analysis to identify the independent FDOM fractions. This provides both a quantitative and qualitative measure of DOM.

Recently, it was shown that the organic matter fluorescence of RAS water is highly sensitive to ozonation and fluorescence spectroscopy could therefore be used as an indirect method to determine ozone delivery within these systems. Therefore, three ozone dosages, including a control, were injected in pilot freshwater RAS where trouts were farmed. The ozonation trial lasted eight days utilising one RAS per dosage. The test levels ranged from 52-130 mg O_3/h, equivalent to 10-25 g O_3/kg feed.

The DOM consisted of four components (Fig. 1) which differed in their fluorescence characteristics and response to ozonation. A UV wavelength fluorescent fraction (C4) typical of proteinaceous material removed by 13-20% immediately after ozone initiation. The remaining fractions that exhibited visible wavelength fluorescence, at first were unaffected but during the following days, were gradually degraded, reaching a removal of 34-66%. By the end of the experiment the fluorescence intensities of all fractions were diminished up to 60% in all applied dosages.
This study provides the first application of fluorescent EEM spectroscopy and PARAFAC analysis to determine the effect of ozone on FDOM character in aquaculture water, more specifically within continuously treated RAS. The results indicate that the response in organic matter fluorescence can be used to depict the impact of ozone dosage.

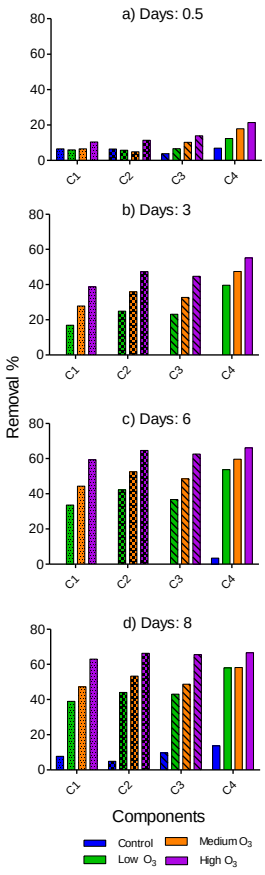

Figure 1: Effect of ozone on FDOM over time.